

BARNSTEAD BRIDGE

(Bridge 097/108)

Barnstead Road spanning the Suncook River

Pittsfield

Merrimack County

New Hampshire

HAER No. NH-30

HAER
NH
7-Pitts,
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD

National Park Service

Philadelphia Support Office

U.S. Custom House

200 Chestnut Street

Philadelphia, PA 19106

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LOCATION: Barnstead Road, spanning the Suncook River, Pittsfield, Merrimack County, New Hampshire.

USGS Pittsfield, NH Quadrangle, Universal Transverse Mercator Coordinates: 19.310670.4797400

ENGINEER/BUILDER: D.H. Dickinson, Chief Engineer, New Hampshire State Highway Department; Eastern States Bridge Company, Concord, New Hampshire, contractor

DATE OF CONSTRUCTION: 1934-1935

PRESENT OWNER: New Hampshire Department of Transportation

PRESENT USE: Highway bridge

SIGNIFICANCE: The Barnstead Bridge is a representative example of a standard-design rigid frame concrete highway bridge, typical of thousands built in the United States from 1922 through the mid-twentieth century.

PROJECT INFORMATION: The Barnstead Bridge was recorded in January 1997 by the Cultural Resource Group of Louis Berger & Associates, Inc., Needham, Massachusetts, for the New Hampshire Department of Transportation (NHDOT). The recordation was undertaken pursuant to a Memorandum of Agreement between NHDOT, the New Hampshire State Historic Preservation Officer, and the Army Corps of Engineers, and accepted by the Advisory Council on Historic Preservation, executed in association with the planned replacement of the subject bridge. Project personnel included Richard M. Casella, Senior Architectural Historian, and Bruce Harms, Photographer.

DESCRIPTION

The Barnstead Bridge (Bridge No. 097/108) is a two-lane single-span rigid frame concrete bridge which carries Barnstead Road in an east-west direction over the Suncook River in the town of Pittsfield, Merrimack County, New Hampshire. The bridge is located in a mixed commercial and residential section of the village of Pittsfield.

The Barnstead Bridge has a clear span of 65' and an overall width of 34'-3", which includes two 12'-0" travel lanes, a 4'-10" sidewalk along the north side, and two railings, each 2'-4" wide. The bridge deck is 7' above normal water elevation and slightly arched, measuring 4'-0" thick at the abutments, and tapering to 2'-0" at the center. The abutments are also tapered, from 4'-0" at the top to 2'-3" at the footing. The railings are cast integral with the deck, and rise 2'-9" above the 11" granite curbing. The inside and outside of the railings, the sidewalls of the bridge, and the abutment wingwalls are all clad with an ashlar granite veneer.

The wingwalls are 19'-0" in length and curve slightly outward to a total offset of 12". The joint between the backwall of the abutment and the wingwalls is offset 6", which visually separates the two elements, making the tapered abutments readily identifiable as the legs of a rigid frame bridge. Four original light poles and lanterns are mounted on the bridge railings above the abutments.

HISTORICAL INFORMATION

Background

The town of Pittsfield was settled in 1768 by John Cram, who explored the area at the request of the town's original proprietors, most of whom resided in Hampton and were anxious to develop the land grant. Cram made his way up the valley of the Suncook River to the falls which lies at the center of present-day Pittsfield village. Satisfied with the suitability of the area, he agreed to settle the land in return for mill privileges, one hundred acres, and the sum of fifteen pounds. In the same year, Cram built a crude log dam across the Suncook River and erected a sawmill. With the lumber he sawed he constructed a superior dam, a larger sawmill, a gristmill, and a dwelling. The following year he moved his wife and family to the location, establishing the first permanent settlement within the bounds of the present town of Pittsfield. Other settlers quickly followed, and in 1782 the town of Pittsfield was incorporated and named in honor of Revolutionary War hero William Pitt. The first town meeting was held at Cram's home, also an inn and tavern, and Cram was elected Town Clerk. Cram later bought an additional 1,100 acres of land, which included most of the present village. He served continuously for forty years in various public offices of the town, including clerk, selectman, and representative, never charging for his services (Hurd 1885:587; Young 1953:63).

The rich soil, available water power, and heavy growth of timber encouraged settlement, and by 1810 the population of Pittsfield had surpassed one thousand. During the nineteenth century the town continued to grow both in agriculture and industry. The waterpower potential of the Suncook River was further developed by James Joy, who in 1815 built a metalworking shop for the production of scythes. Joy utilized the lower mill privilege, just below Cram's mills, to drive his trip hammers. In 1826, Joy built a five-story woolen mill which he fitted with the latest looms and machinery, purchased from Valpy, Richardson and Company of Andover, Massachusetts (*The Granite Monthly* 1921:490, 491; Young 1953:66).

The opening of the Suncook Valley Railroad in 1869, connecting Pittsfield and Suncook, ushered in another era of industrial growth to the town. A huge shoemaking factory, housing three separate shoe manufacturing concerns, was erected in Pittsfield by a shoe manufacturing company from Lynn, Massachusetts. The steam-powered factory employed more than 400 workers and led to a tremendous surge in the growth of the town. The prosperity was short-lived, however; the owners became unhappy with labor disputes and closed the factory after only six years. Several desperate years followed for Pittsfield, until in 1879, C.B. Lancaster, "an extensive and successful shoe manufacturer," offered to establish a factory in the town. Lancaster's offer was made contingent upon several demands, which were met by the town, including the building of a new factory at the town's expense and exemption from taxation for a number of years. By 1885, C.B. Lancaster and Company was employing nearly five hundred workers and doing over a half million dollars in business annually. The original shoe factory, which had remained empty for several years, was occupied in the early 1880s by Morgan, Door and Libby, manufacturers of "superior ladie's goods." Another larger employer was the Pittsfield Manufacturing Company, which produced cotton goods (Hurd 1885:589).

The town suffered severe upheaval during the 1890s, when the introduction of labor organizations, coupled with an economic depression, disrupted the local industries. The town's population dropped by nearly five hundred people over the course of the decade. The economic situation improved after the turn of the century, and by 1910 the population had grown slightly, to 2,222 (Hans Klunder Associates 1964:2).

Manufacturing jobs in Pittsfield declined sharply following the depression of the 1890s, and continued to decline through the twentieth century as businesses moved to the southern states to take advantage of more attractive labor conditions. In the latter half of the twentieth century, the local economy has expanded slightly in the area of tourism, but has failed to regain its previous prosperity.

History of Barnstead Bridge

The first bridge crossing the Suncook River at the point of the Barnstead Bridge was a wood-pile, timber-frame deck bridge erected in 1841 by John Berry. The bridge was built by the town,

along with a new, shorter road to Barnstead. This bridge was replaced by the first covered bridge in Pittsfield, built in 1884 by E.S. Carroll of Laconia, New Hampshire. Construction of the covered bridge was supervised by town selectmen E.W. French, J.P. Watson, and W. Tasker. The Carroll Bridge, as it became known, was a lattice truss of 65' span, which cost \$1,796.88 to erect (*The Valley Times* 1934b:1, 1934c:1; Young 1953:142).

A warm spell in early April 1934 swelled the Suncook River, and on April 6 of that year, high water and ice carried away the "wooden horses" which had been erected under the bridge as temporary supports (*The Valley Times* 1934a:1). This misfortune prompted the State Highway Department to begin formal planning for a replacement bridge. On May 17, 1934, state engineers conducted a site and property survey. They returned four days later to perform ten soil borings in order to determine the footing requirements for the bridge. Plans were drawn by the highway department and approved on September 13, 1934, by Chief Engineer Daniel H. Dickinson (New Hampshire State Highway Department 1934).

The choice of a rigid frame concrete bridge design by the highway department engineers was made for a number of reasons, the primary consideration being economy and service life. Concrete bridges in general were the choice for short-span highway bridges, and the relatively new rigid frame type offered a number of advantages over other types. The history and attributes of the rigid frame bridge are discussed in greater detail below. By 1934, the New Hampshire State Highway Department was one of fifteen state highway departments in the United States that had adopted the rigid frame bridge as a standard design; among the other states to adopt the design were Connecticut, Maine, and Massachusetts in the New England area (*Engineering News-Record* 1933:531-533).

The Barnstead Bridge project was undertaken by the highway department with funds from the trunk line bridge account (TLB), which was created under state law to provide for the reconstruction and maintenance of trunk line and state-aided highways. The bridge, completed in 1935, was one of ten rigid frame bridges built by New Hampshire in that year (New Hampshire State Highway Department 1936:125, 132).

In October 1934, the state publicly announced that the Carroll Bridge would be closed and immediately torn down, and a new concrete bridge erected in its place. Traffic would be detoured via Bridge Street, River Road, and High Street. The local paper, *The Valley Times*, reported that the bridge would cost approximately \$24,000, which would be borne by the state and federal governments. The contractor, Eastern States Bridge Company, Inc., of Concord, New Hampshire, announced that it would utilize local labor "in so far as possible." The hiring of local workers was a common practice in the construction of concrete bridges, which involved an intensive amount of carpentry labor for the formwork as well as unskilled labor for excavating, cement mixing, and material handling (*The Valley Times* 1934b:1, 1934c:1).

In 1932, Angus Ferguson was the president of Eastern States Bridge Company, Inc., which operated out of an office at 3 North Street in Concord. Ferguson had previously listed himself in the city directory (1929) as a "bridge engineer." From 1933 to 1939, although Eastern States Bridge Company was not listed in the directory, Ferguson continued to be listed as a bridge engineer, apparently working from his home at 63 Broadway. Ferguson appears to have kept his operations to a minimum, assembling employees and equipment as needed when he won contracts. Under the Eastern States Bridge Company name, Ferguson is known to have erected at least six bridges in New Hampshire, including one other rigid frame concrete bridge, in Woodstock, in 1933 (Garvin 1997).

Work on the new bridge progressed into the winter months, and by early December 1934 a cofferdam was completed around the west abutment, the abutment footing hole was excavated to a depth of 30', and the concrete formwork was under construction (*The Valley Times* 1934d:1).

On January 18, 1935, the *Valley Times* reported that construction on the bridge was progressing slowly but steadily, but that high water and ice cakes were "playing havoc" with the formwork on the eastern side. A temporary bridge three feet in width had been erected alongside the new bridge for foot traffic and was greatly appreciated by the townspeople. However, the detour for vehicles and teams was deemed a "disgrace," due to traffic jams and the nearly impassable condition of the road. In one day alone, over a hundred cars had to be towed through the mire. Pittsfield merchants complained that the difficult conditions were resulting in "a decided drop in business" (*The Valley Times* 1935a:1).

By March 22, 1935, all of the concrete work for the bridge had been completed and filling had begun behind the abutments (*The Valley Times* 1935b:1). The bridge was largely completed by April 4, 1935, and was opened to traffic on that day. The first car to cross the bridge carried Lawrence Davisson, the construction supervisor for Eastern States Bridge Company; William Bailey, the project supervisor for the highway department; the Pittsfield Chief of Police; and Mrs. Burt Avery of Pittsfield. The stonework facing over the concrete, application of a Tarvia road surface, and the installation of electric post lights were completed over the three weeks following the opening (*The Valley Times* 1935c:1).

Other than repairs to the railing, curbs, and sidewalk made in 1940, the bridge served well until the 1970s, when deterioration of the concrete on the underside of the deck was observed during inspection by state highway engineers. The spalling had exposed the steel reinforcement, which exhibited corrosion. Subsequent inspections uncovered stress cracks in the deck and abutments. Repairs to the concrete on the underside of the deck were made in 1979, and a new wearing surface was put down in 1980. During the 1980s, inspections revealed continuing spalling, cracking, and structural deterioration, and the bridge was scheduled for replacement (New Hampshire Department of Transportation 1997).

History of the Rigid Frame Concrete Bridge

The rigid frame concrete bridge is a deck bridge that differs from a simple span bridge supported on abutments in one important way. In the rigid frame bridge, the connection at the deck and the abutments is rigidly joined with steel reinforcement bent at a right angle and tied to the reinforcement in the deck and abutments. The abutments then function additionally as legs which resist the loads placed on the deck by means of torsional strains transmitted through the solid connection. The overturning forces on the abutments are resisted by compression of the deck. The rigid frame bridge is known as a continuous structure, which when first introduced could be designed as a much lighter and stronger structure, with a thinner deck and abutments, than a simple span of equivalent length. The design has several practical benefits, the most obvious being a cost savings in concrete. Rigid frame bridges are generally simpler to build than other types of concrete bridges, and can be adapted to erection utilizing the cantilever method. The opening under the bridge is rectangular, which offers a greater area for stream or traffic flow as compared, for example, to a concrete arch bridge (Portland Cement Association 1936:5).

The first rigid frame concrete bridge in the United States was designed in 1922 by Arthur G. Hayden, engineer with the Bronx Parkway Commission in New York. Beginning in that year, and until 1925, eight bridges of the type designed by Hayden were built by the commission over the Bronx Parkway. In 1925, the Bronx Parkway Commission was dissolved and reorganized as the Westchester County (New York) Park Commission, which, under Hayden's direction, continued the use of the rigid frame bridge in conjunction with its massive Hutchinson Parkway and Cross County Parkway construction projects. Over the next five years, Westchester County built seventy-one Hayden-designed rigid frame bridges (*Engineering News-Record* 1933:531-533).

In 1926, Hayden wrote a paper entitled "Rigid Frames in Concrete Bridge Construction," in which he described the strength, economy, and architectural merits of the design (Hayden 1926). In addition, he presented two methods of structural analysis and drawings of the arrangement of steel reinforcement utilized in several different forms of rigid frame bridges. Hayden's analytical methods were embraced by the engineering community and his designs were widely copied. By 1932, more than 200 rigid frame concrete bridges had been built in the United States, and Hayden was recognized by his peers as the father of the bridge type and its leading expert (Baretta 1932:558; *Engineering News-Record* 1933:531; Portland Cement Association 1936:5).

The popularity of concrete bridges, particularly those of the rigid frame type, soared during the Great Depression, due to tight money and government-sponsored bridge-building programs. The federal government stepped up the funding of grade elimination projects in connection with railroad crossings and the construction of parkways and superhighways. Economical, long-lasting, and capable of being built with local labor, the concrete bridge put federal highway dollars targeted for economic relief directly into the hands of laborers, who needed it most (*Engineering News-Record* 1933:531).

The majority of technical papers written on the subject appeared during the Depression years and led many American engineers to believe that the rigid frame bridge was a new design, of American creation. In a letter to the editor of *Civil Engineering*, A.A. Brielmaier, a civil engineer from Cleveland, set the record straight by listing dozens of bridges of the same type which had been built in Europe during a ten-year period beginning in 1904 (Brielmaier 1932:653).

The popularity and acceptance of the rigid frame concrete bridge reached a peak in the United States in the late 1930s, due in part to the publications of standards and design guides, such as *Analysis of Rigid Frame Concrete Bridges* by the Portland Cement Association (Portland Cement Association 1936).

The development of precast and post-tensioned concrete girders and deck sections which offer greater quality control and faster and cheaper erection than cast-in-place bridges has pushed the rigid frame concrete bridge into disuse today.

BIBLIOGRAPHY AND REFERENCES CITED

Brielmaier, A.A.

1932 Early Rigid Frame Bridges. *Civil Engineering* 2(10):653 (October).

Engineering News-Record

1933 Ten Years of Achievement with Rigid Frame Bridges. *Engineering News-Record*, April 27, pp. 531-533.

Garvin, James L.

1997 Personal communication, January 19, from James L. Garvin, Architectural Historian, New Hampshire Division of Historical Resources, Concord.

Granite Monthly, The

1921 150th Year Celebration, Pittsfield, New Hampshire. *The Granite Monthly*, November, pp. 476-498.

Hans Klunder Associates

1964 *A Comprehensive Plan for Pittsfield, New Hampshire*. Hans Klunder Associates, Hanover, New Hampshire.

Hayden, Arthur G.

1926 Rigid Frames in Concrete Bridge Construction. *Engineering News-Record*, April 29, pp. 686-689.

Hurd, D. Hamilton (editor)

1885 *History of Merrimack and Belknap Counties, New Hampshire.* J.W. Lewis & Company, Philadelphia.

New Hampshire Department of Transportation

1997 Inspection Reports, Barnstead Bridge. On file, New Hampshire Department of Transportation, Concord.

New Hampshire State Highway Department

1934 Drawings of Barnstead Bridge over Suncook River, Town of Pittsfield, New Hampshire. Four sheets dated September 9, 1934. On file, New Hampshire Department of Transportation, Concord.

1936 *Thirteenth Annual Report of the State Highway Department of New Hampshire.* New Hampshire State Highway Department, Concord.

Portland Cement Association

1936 *Analysis of Rigid Frame Concrete Bridges*, Portland Cement Association, Chicago, Illinois.

United States Geological Survey

1987 *Pittsfield, New Hampshire, 7.5 Minute Quadrangle.* United States Geological Survey, Reston, Virginia.

Valley Times, The

1934a High Water. *The Valley Times*, April 6, p. 1.

1934b Will Build New Bridge on Barnstead Road. *The Valley Times*, October 5, p. 1.

1934c Old Covered Bridge to be Replaced by Cement Structure. *The Valley Times*, October 26, p. 1.

1934d Work Progressing. *The Valley Times*, December 7, p. 1.

1935a Construction of New Bridge Progressing. *The Valley Times*, January 18, p. 1.

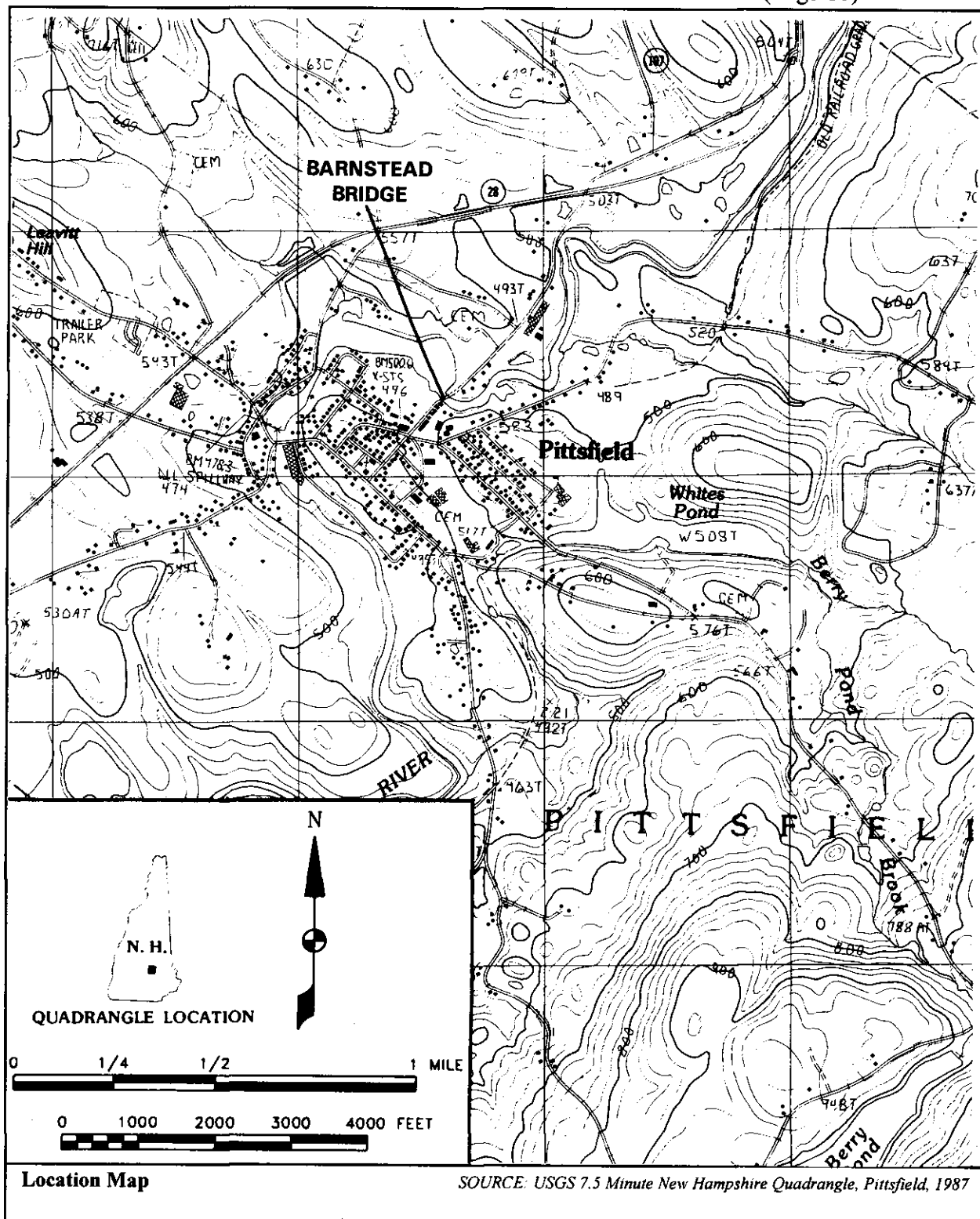
1935b New Bridge Soon Open. *The Valley Times*, March 22, p. 1.

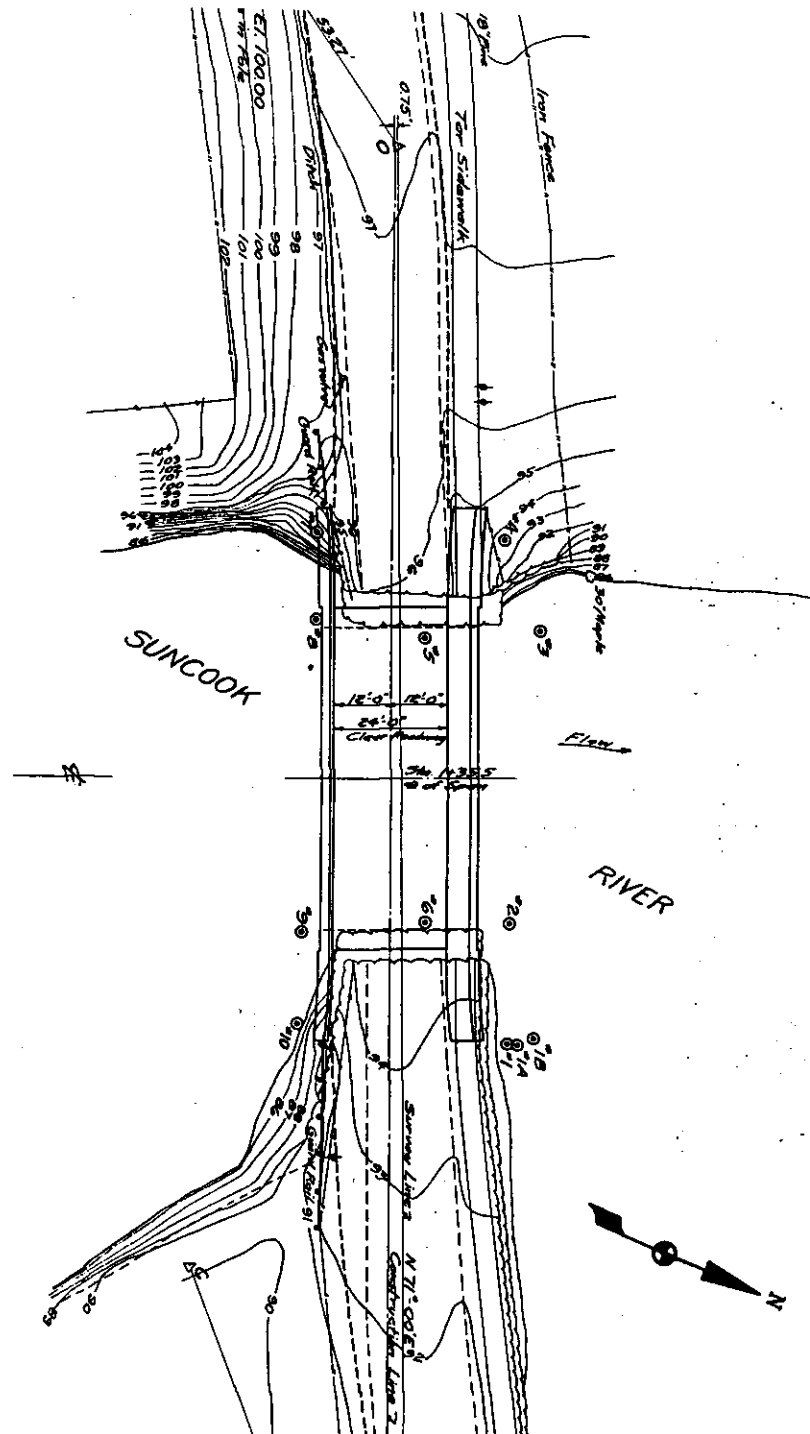
1935c New Bridge Opened. *The Valley Times*, April 5, p. 1.

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Young, E. Harold

1953 *History of Pittsfield, New Hampshire.* Granite State Press, Manchester, New
Hampshire.





Barnstead Bridge, Site Sketch